

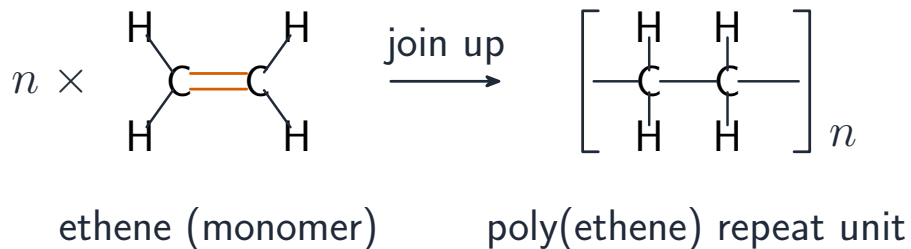
Exercise walk-through

11.8

Polymers

IGCSE Chemistry

Polymers



A **polymer** joins many **monomers**.

- **addition** – alkenes join, no other product
- **condensation** – water lost (nylon, PET)

Many plastics do not break down.

Fuels



The three **fossil fuels** are **coal** , **natural gas** and **petroleum** .
Methane is the main part of natural gas; petroleum is a mixture of **hydrocarbons** – compounds of hydrogen and carbon *only*.

Plastics and the environment



Most plastics are non-biodegradable, so waste plastic collects on beaches and in the oceans for hundreds of years

The two condensation polymers, and the plastic problem

polyamides

made from a dicarboxylic acid and a diamine; **nylon** is one

polyesters

made from a dicarboxylic acid and a diol; PET is one, and it can be recycled

what is lost

a small molecule – water, or HCl – at every link formed

why plastics persist

most are non-biodegradable, so they build up in landfill sites

in the sea

they collect in the oceans and harm sea life

burning them

releases carbon dioxide, and toxic gases from some plastics

Two functional groups per monomer is what makes a chain possible. That is why a diacid needs a diamine or a diol, not a simple alcohol.

Two condensation polymers, two linkages

Condensation polymerisation

Condensation polymerisation joins monomers and expels a small molecule – usually water – at each join.

Ester linkage

A diol plus a dicarboxylic acid gives a polyester, joined by the **ester linkage** —COO— .

Amide linkage

A diamine plus a dicarboxylic acid gives a polyamide (nylon), joined by the **amide linkage** —CONH— .

The repeat unit

Draw the **repeat unit** with a bond crossing each bracket – that is what shows the chain continues.

Addition polymers keep every atom; condensation polymers lose a small molecule at every link. That is the whole difference.

Exercises 2.1·2.2

2.1 Define a polymer.

[1]

2.2 Name the monomer used to make poly(ethene).

[1]

Exercises 2.1·2.2

2.1 Define a polymer.

[1]

2.1

- a polymer is a **very large molecule** made from many **monomers** joined together
-

2.2 Name the monomer used to make poly(ethene).

[1]

2.2

- the monomer for poly(ethene) is **ethene**

Exercise 3.1

3.1 In addition polymerisation, the number of products formed is:

[1]

☐

A one (the polymer only)

B two

C three

D none

Exercise 3.1

3.1 In addition polymerisation, the number of products formed is:

[1]

☐

A one (the polymer only)

B two

C three

D none

3.1 A

- addition polymerisation makes **only the polymer**
- B and C would be condensation; D is false

Exercise 3.2 (a)

3.2 Poly(ethene) is made from ethene.

(a) State what happens to the C=C double bonds during polymerisation.

[1]

Exercise 3.2 (a)

3.2 Poly(ethene) is made from ethene.

(a) State what happens to the C=C double bonds during polymerisation. [1]

(a)

- the C=C double bonds **open up** so the monomers can join

Exercise 3.2 (b)

3.2 Poly(ethene) is made from ethene.

(b) Draw the repeat unit of poly(ethene).

[2]

Exercise 3.2 (b)

3.2 Poly(ethene) is made from ethene.

(b) Draw the repeat unit of poly(ethene).

[2]

(b)

- $-(\text{CH}_2 - \text{CH}_2)-$ in brackets with continuation bonds

Exercise 3.3

3.3 Many plastics are not biodegradable. State two problems this causes for the environment. [2]

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3.3

- any **two** of: build up in landfill / collect in oceans and harm sea life / burning releases toxic gases